ROLE OF GRID COMPUTING IN BUSINESS GROWTH

Meenakshi Gupta*

Amit Kapoor*

Vasudha**

Ruchi Mittal***

ABSTRACT

Grids are very large-scale virtualized, distributed computing systems. These allow users to access the computing resources of heterogeneous computer systems distributed around the world as a single unified system. Grid computing enables enterprises to make full utilization of their existing computer power as well as to maximize productivity by combining the resources of different computers and utilizing them to achieve a common objective. This will change the way business is done. It will make businesses more competitive by improving their productivity and efficiency; and will reduce business cost by saving time and resources. Although the grid computing provides a lot of potential in business growth, yet its use is quite limited at present. Only a small number of businesses are deploying Grid-related technologies and none of the small scale businesses consider using the Grid at the moment. Therefore in order to encourage more businesses to adopt grid computing, it is necessary for them to understand the benefits they could gain from using the grid. This paper discusses briefly the benefits of grid computing and some of its applications in various business sectors.

Keywords: *Grid computing, computing resources, resource sharing, business growth.*

*Assistant Professor, Maharaja Agrasen Institute of Management and Technology, Jagadhri, Haryana.

**Lecturer, Maharaja Agrasen Institute of Management and Technology, Jagadhri, Haryana.

***Head, MCA Department, Maharaja Agrasen Institute of Management and Technology, Jagadhri, Haryana.

1. INTRODUCTION

In computing, the main focus has been on the efficient utilization of computer resources so that idle computer resources can be utilized to its maximum extent. The grid computing has changed the way the computer resources are utilized. Now this is not limited to a computer system or to the computer resources that are connected with a server in an organization. The underutilized computing power of an organization can be used by others that are connected to it, or reversely if organization needs some more computing power at any time, it can get it from them.

Grid computing has the ability to distribute jobs to many server components using load sharing software that distributes the load evenly based on resource availability and policies. Now instead of having one heavily burdened server the load can be spread evenly across many smaller computers. The distributed nature of grid computing is transparent to the user. When a user submits a job he doesn't have to think about which machine his job is going to get executed on. The "grid software" will perform the necessary calculations and decide where to send the job based on policies. [2]

Grid computing holds a lot of potential in many industries with respect to saving costs, improving efficiency, creating new services and products, increasing product quality, creating new business opportunities as well as improving collaboration between companies. This will change the way business is done. The solutions that Grid provides range from small and simple to large and complex one. Grid users can also vary from small institutions to multinational business leaders. At present, grid Computing is mostly used as a mean for simplifying resource management. Because of that only a small number of companies are deploying Grid-related technologies and none of the small companies (SMEs) consider using the Grid at the moment [11]. To make the Grid being adopted, businesses need to understand the benefits they could gain from using the Grid. This will help them to understand that how they can save the money and time by implementation of grid in their businesses.

This paper discusses the grid from the perspective that how it could be beneficial in the growth of a business. Section 2 gives the introduction to grid computing architecture. Section 3 discusses the benefits that a business can get from the adoption of grid. Section 4 presents an overview of grid penetration in various business sectors. Section 5 shows its effect on growth of IT sector itself.

2. GRID COMPUTING ARCHITECTURE

Grid computing is a form of distributed computing. The grid is an infrastructure that bonds and unifies globally remote and diverse resources in order to provide computing support for a wide range of applications. Rajkumar Buyya defines Grid as “a type of parallel and distributed system that enables the sharing, selection, and aggregation of geographically distributed "autonomous" resources dynamically at runtime depending on their availability, capability, performance, cost, and users' quality-of-service requirements.” [5]

Grid architecture depicts the fundamental components of grid, describes their function, and indicates how these components should interact. It is often described in terms of "layers", where each layer has a specific function. The higher layers are generally user-centric, whereas lower layers are more hardware-centric, focused on computers and networks. Different layers of grid are shown in following figure.

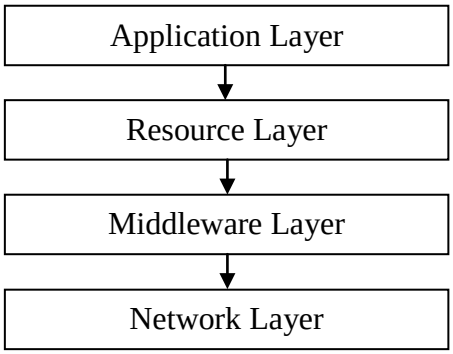

Fig. 1 Grid Layered Architecture

- The bottom layer is the network, which assures the connectivity of the resources in the Grid.
- On top of it lies the resource layer, made up of the actual resources that are part of the Grid such as computers, storage systems, electronic data catalogues, sensors and telescopes.
- The middleware layer is the intelligence that brings the various elements together in a grid. It provides the tools that enable the various elements (servers, storage, networks, etc.) to participate in a grid.
- The highest layer is the application layer, which includes all different user applications, portals and development toolkits. This is the layer that users of the grid "see" and interact with. The application layer often includes the service-ware, which performs

general management functions like tracking who is providing grid resources and who is using them [5].

3. GRID COMPUTING AND BUSINESS GROWTH

Businesses now-a-days are completely dependent on IT to operate, function, and take appropriate decisions. Grid computing is one such concept that can enable businesses to make more efficient use of its existing resources. It enables IT resources to be shared and dynamically allocated to business applications according to their requirements. If resources are underutilized then these can be allocated to others, on the other hand if more resources are required at any specific time, these can be added flexibly and inexpensively.

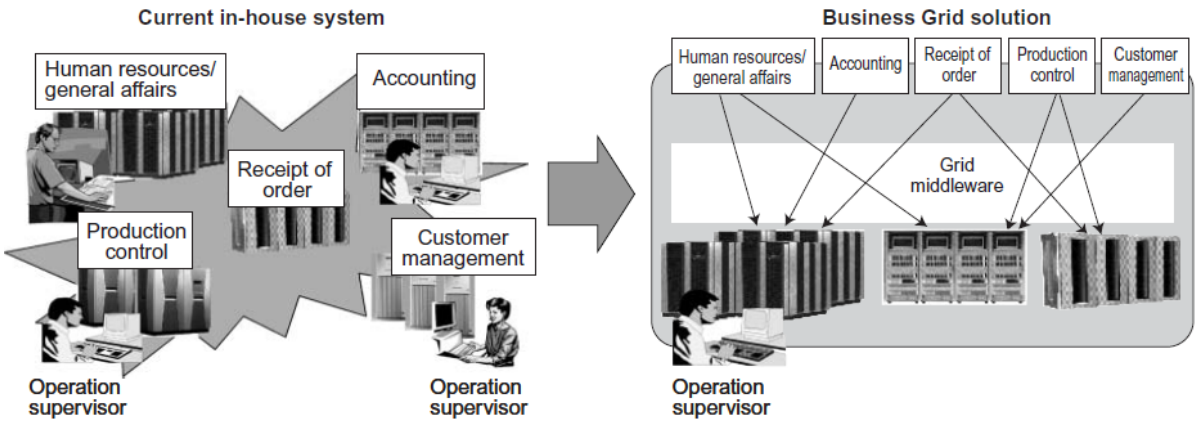

Fig. 2 Efficient use of computing resources using Grid Computing [3]

Here are some ways in which grid computing can enable enterprises to achieve business transformation and growth [4, 6].

Manages IT infrastructure & lowers costs - Grid computing will create new opportunities to better manage a larger, more distributed IT infrastructure by virtualizing the resources on the grid and more uniformly handling heterogeneous systems. It will be easier to visualize capacity and utilization, making it easier for IT departments to control expenditures for computing resources over a larger organization. According to S.P.S. Grover, vice president (technology sales) of Oracle India, “The high grid adoption rate implies the readiness and maturity of Indian enterprises to invest in modern, flexible, and dynamic information technology infrastructure and commercial grid computing.

Ensures efficient data storage - Grid computing helps enterprises to manage their business information effectively and ensure efficient data storage. Usage of grid computing enables the organizations to operate without any worries on issues related to their data. They no longer have to worry about where their data is stored.

Helps in meeting market demands - Grid computing brings tremendous productivity and efficiency to organizations facing the challenges of changing demand conditions. It makes possible to share computing resources across networks, creating what amounts to virtual super computers. Grid computing infrastructure continually analyses demand for resources and adjusts supply accordingly.

Aids in solving common problems within enterprises - It aims to solve common problems within enterprise IT including the problems of underutilized-dedicated hardware resources, unwieldy systems that are expensive to maintain and difficult to change, and fragmented and disintegrated information that cannot be fully exploited by the enterprise as a whole. Grid computing allows the tackling of problems that were earlier approached only using an enormous computing power.

In general terms, the utilization of Grid Computing in business environments provides a rich and extensible set of business benefits. There have been a significant number of commercialization efforts, which support Grid Computing in every sector of the marketplace [1]. In a functional sense, grids are a way to build "dynamically constructed problem solving environments using distributed and federated high performance computing and data handling infrastructure that manages geographically and organizationally dispersed resources." [7] In their most basic form grids provide two functions: they link databases called *Data Grids* or they create new processing power by linking computers called *Computational Grids*. More sophisticated types of grid technology join the two core functions — data grids and computational grids — in a single grid, called an *Enterprise Grid*, which interconnects databases and provides processing power. Companies may also link partners or suppliers to their Enterprise Grid, resulting in a *Partner Grid*. Table 1 shows different types of grids and their impact on business [8].

Table 1 Grids and their impact on business

Type of Grid	**Business Impact**
Data Grid	Significant savings in finding information. Efficiency gains due to shortening the time R&D or design staff need to find information.
Computational Grid	Big savings in processing time. Adds to efficiency by providing for greater output. Savings on R&D and design costs.
Enterprise Grid	Efficiency due to processing power plus access to data.

	Savings on R&D time and time to market. Upside in terms of greater output/sales.
Partner Grid	Savings in design time and R&D time, plus time to market. Permits more efficient collaboration between partners often in supply chain relationship.

4. SOME APPLICATION AREAS OF GRID COMPUTING

Many organizations have started identifying the major business areas for Grid Computing applications. Some of the sectors that have shown interest in grid computing include – life sciences, financial services, engineering, media, weather forecasting etc. The areas and scope of its application is increasing at a very fast pace. A brief overview of the application of Grid Computing in various domains is given below to give an idea of the increasing use of Grid Computing [1, 8, 9, 10, 13]:

Health Care Industry - One of the most obvious applications of grid computing is in medicine. It can handle administrative databases, medical image archives and specialized instruments. This could enhance diagnosis procedures, speed analysis of complex medical images, and enable life-critical applications. It has been useful in a variety of situations like producing interactive medical simulations like heart simulation and in analyzing and managing medical images.

Aerospace Industry - Aerospace firms are primarily using cluster computing for design and development. They have also begun to adopt Data Grids to enable groups to access important databases. The growth of Enterprise Grids in the aerospace sector appears likely to be slow, although more collaborative product development efforts with partners might speed the adoption of grids and result in Partner Grids expanding faster. Firms like Boeing have already begun using grid computing and other firms, such as British Aerospace, are involved in test-beds employing grids, mostly in Europe.

Financial-Services Industries –The financial-services industry has been a pioneer in the application of high performance computing technology and is today a leader in the application of grid technology. Grids are promising for securities trading, for tasks such as performing risk and derivative calculations, trading decision support, performing “what if” analyses to assist in building optimization strategies, and in data mining. They can be equally useful in banking, asset management and insurance, speeding up tasks such as risk analysis, fraud detection and actuarial analysis.

Research Collaboration - Research-oriented organizations and universities practicing in advanced research collaboration areas require the analysis of tremendous amounts of data. The Grid Computing provides mechanisms for resource sharing by forming one or more virtual organizations providing specific sharing capabilities. Such virtual organizations are constituted to resolve specific research problems with a wide range of participants from different regions of the world. It also has the capabilities to dynamically add and delete virtual organization participants, manage the "on-demand" sharing of resources, plus provisioning of a common and integrated secure framework for data interchange and access.

Manufacturing - The enormous competitive pressure in the business and industry sectors today afford most engineering and design far less turnaround time. They need mechanisms to capture data, speed up the analysis on the data, and provide faster responses to market needs. These engineering activities and design solutions are inherently complex across several dimensions, and the processing requirements are much more intense than that of traditional solutions of the past. Grid computing systems provide a wide range of capabilities that address the above kinds of analysis and modeling activities.

Collaborative Games - There are collaborative types of Grid Computing disciplines that are involving emerging technologies to support online games, while utilizing on-demand provisioning of computation-intensive resources, such as computers and storage networks. The resources are selected based on the requirements, often involving aspects such as volume of traffic and number of players, rather than centralized servers and other fixed resources. These on-demand-driven games provide a flexible approach with a reduced up-front cost on hardware and software resources.

Media - The major challenge facing media applications is the production, broadcasting, delivery and play out of interactive media content such as audio, video, image in real time. Grid solutions have been developed for this, these include, the Grid Visualization Kernel (GVK) which allows the visualization pipeline (data enrichment/reduction, followed by mapping of the data to an abstract form, and finally composing the visual image) to be ported to grid resources, and also handles the communication between the simulation generating the data and the visualization of the simulated data and G-Vid which is based on GVK which allow the production of real time interactive MPEG4 compliant video content on the grid.

Weather Forecasting - Another field with huge data generation and processing requirements is weather forecasting. Both local weather data stations and satellites collect and transmit large volumes of data for analysis. Networks of detectors have been placed in the ocean in many locations to detect tsunamis and predict their size and course to permit timely

evacuations of coastal areas. Grid Computing has been very extensively used for forecasting of weather and other natural catastrophic events.

Astronomy - The major challenge facing the field of astronomy is the analysis of tera-bytes of astronomical image data generated by telescopes. Moreover, astronomical image capturing devices can generate several images, each of hundreds of Mbytes, per single shot. This necessitates data intensive computation, scalable file I/O in the order of GB/s, replica management and parallel/distributed processing of files. As a grid solution, the GFARM Grid file system offers a special purpose Grid middleware for data intensive computation.

Other Industries - There are several other industries where grids are proving to be significant. The electronics industry is using grids and collaborative computing for electronic design. For example, AMD was able to bring a product to market nine months earlier than the usual 24-month development time, a significant saving. Some firms in the entertainment industry have already used grid computing to shorten the time to do animations and complete the entire "rendering" for an animated film. The oil and gas industry is also an important user of grids because it has many sources of seismic data [8]. In agriculture, grid computing helps to power research projects aiming to optimize farming practices, improve animal health, and fast-forward the search for agriculturally useful genes. With the time a number of other sectors are becoming aware about the uses of grid computing and taking a step toward the implementation of it.

5. IMPACT ON IT INDUSTRY

The adoption of grid computing by different business sectors will definitely have a great impact on IT industry. It will gain by selling products and services related to grid to the industries. This will directly affect the industries that deal in electronic components, computers, software, data storage and processing, communication equipments. This will also put a significant pressure on telecommunication service providers supplying bandwidth. The grid technology will likely form the foundation of a fourth wave in IT, and present new opportunities for the long-suffering telecom industry [14]. The skills required to operate grid will be high in demand. As grid computing technologies mature, new business opportunities for IT industry will emerge. The various IT companies such as HCL, IBM, Infosys, Intel, Oracle, TCS i-Lab, 3Tera, Gridwell, Parabon, Avaki, HP provide grid solutions that make grid computing a powerful strategy for enterprise today. Many grid projects and activities are taking place around the world at national and international level. There are also field specific grids that are created to tackle specific field problems. Businesses are creating their private

grids also called local grids or intra-grids in order to have the benefits of grid computing [12]. Some examples of the grid projects are shown in Table 2.

Table 2 Grid-powered projects

Grid based project	Detail
EU-IndiaGrid	Brings together over 500 multidisciplinary organisations to build a grid-enabled e-science community aiming to boost R&D innovation across Europe and India.
EUAsiaGrid	Aims to pave the way towards an Asian e-Science Grid Infrastructure, in synergy with the other European grid initiatives in Europe and Asia.
APGrid	An open community encouraging collaboration for Grid computing in the Asia Pacific region.
EDGI	It concerns with the extension of the existing Distributed Computing Infrastructures (cluster Grids and supercomputer Grids) with public and institutional Desktop Grids and Clouds within Europe.
Distributed Aircraft Maintenance Environment (DAME)	To access and analyse maintenance data from aircraft engines in flight.
myGrid	Bioinformatics and e-science project that helps scientists to make use of distributed resources such as analysing genome data.
Gridcast of BBC	To share broadcast material and resources across the BBC's distributed network
eBay.com	Online auction and shopping based website to buy and sell goods and services worldwide
GARUDA	India's first national grid initiative bringing together academic, scientific and research communities for developing their data and compute intensive applications with guaranteed QoS. Its partners include ERNET-HQ in Delhi, C-DAC and various research & academic institutions.
World Community Grid (WCG)	An effort to create the world's largest public computing grid to tackle scientific research projects that benefit humanity such as

	human genome, HIV, dengue, muscular dystrophy, cancer, influenza, rice crop yields, and clean energy.

Grid computing is changing the way the world is doing science, as well as business, entertainment, social science and more. So grid technology is providing the ways to explore new ways of doing business. They can now share data, data storage space, computing power, and results and can take their business to new heights.

6. CONCLUSION

This paper shows the benefits of grid computing and how the grid computing is penetrating in various business sectors such as financial services, health care, weather forecasting, engineering, astronomy etc. These sectors are biggest customers of grid software vendors and find the web services based on grid computing as the most secure way to share information, rapid access to databases and fast connection between businesses. Grid computing is definitely bringing qualitative changes in the way firms run their businesses. Businesses are adopting grids and web services as they are finding that their competitors are ahead of the game by implementing it. Small industries can also take the advantage of it. They can choose cost effective scaling with "pay as you grow" procurement strategy. Grid infrastructure will help them to attract and enable new business opportunities.

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